VI.—On some Singular Larval Forms of Beetle to be found in Borneo. By C. J. Gahan, M.A.

Amongst the more remarkable forms of insect life to be met with in Borneo, there are few which appeal with stronger interest to the entomologist than do certain creatures, of strange and uncouth shapes, which have all the characters of beetle larvæ, but which yet have never been known to turn into the recognizable form of the fully developed beetle. Insects of a similar type occur in Java and other islands of the Malay Archipelago, as well as in the Malay Peninsula and in Ceylon. Some of them have been known to entomologists for nearly a century. But even to this day no one has been able to say with certainty exactly what they are; and they still remain something of a mystery and a puzzle to the entomologist. And it is for the purpose of trying to enlist help in the elucidation of the problem that I have been invited to give the readers of this Journal a short account of these interesting little creatures, and to state in what direction I think assistance in making out their life-history might be best applied.

Some of these beetle larvæ (see fig. 1), for so we must regard them, have a great resemblance to the fossil trilobites, and hence have come to be known as "trilobite" larvæ, although their resemblance in form to the nymphs of ancient cockroaches is even still more striking. If found fossil in some of the older rocks, they would almost certainly be mistaken for insects of the latter kind. There can, however, be no question that they are beetles; and the only points in that respect remaining to be settled are to what family of beetles they belong, and to what genera or species in that family. Efforts to settle these

points have been made by a few zealous naturalists, including Mr. H. N. Ridley at Singapore, and Mr. J. C. Moulton and the late Mr. Shelford in Borneo, who have kept the larvæ alive a long time, extending even up to two years, in the hope of seeing them pupate and change into beetles, but so far without success.

Mr. Moulton has been good enough to bring over to London living specimens of two of the species which are

Fig. 1. Larva seen from above. Nat. size.

Fig. 2. Larva seen from below. Nat. size.

Fig. 3. A second form of larva seen from above, with head extended. Nat. size.

to be found in Borneo. He gave them to me early in June; and they are still alive (in December), apparently happy and contented with the diet of damp, rotten wood which he had considerately provided for them. But on no occasion have I been able to see them feed; and it is still doubtful whether their food be vegetable or animal matter. Through the kindness of my friend Mr. Hugh Main, I am able to reproduce as illustrations the excellent photographs which he has made of these two forms, one as seen both from above and below (figs. 1 and 2), and the other on the upper side only. In the latter (fig. 3) the narrow head of the larva may be seen extended, as it usually is when the creature is moving about on the wood, apparently in search of food. Its short antennæ, or feelers, ending in a sort of corrugated knob, can be drawn in and out like the horns of a snail, but somewhat more quickly. On each side of the head is a single, simple eye, like that of a glowworm larva. The front jaws, or mandibles, are not

adapted for biting or cutting, but, inserted near the middle line of the head, are curved downwards and outwards like a pair of tusks, of not very hard texture, which seem as if they could be used only for piercing soft tissues; and they do not appear to be perforated with a canal like the nipping jaws of the larvæ of the Lampyridæ or glow-worms. The jaws are altogether constructed like those of the larvæ of Lycidæ, a family of beetles which usually display tawny orange or reddish colours, more or less varied with black. In the structure of the ventral side of the first thoracic segment, as seen in fig. 2, these remarkable larvæ agree also with the known larvæ of Lycidæ. And it is highly probable that Westwood, Kolbe and Bourgeois were right in referring them to the latter family.

But they were wrong, I think, in suggesting that they belonged to the genus *Lycus*. The large and flattened-out form of the larvæ was probably the chief reason for that suggestion, the species of the genus *Lycus* being the largest of the family, and provided with large expanded wing-cases. A large size in the larva does not necessarily mean a correspondingly large size in the beetle into which it develops. Many species of beetle are surprisingly small as compared with the size of the larvæ from which they come. Moreover, the larvæ of two species of *Lycus*, one from Ceylon and one from Borneo, are known, and are so very unlike the creatures we have been discussing, that the latter could hardly belong to any other species of the same genus. If these larvæ ever do change into beetles of the ordinary type, it must, I think, be into beetles of some other genus than *Lycus*, and what that other genus may be is one of the things we wish to find out. This may be done by someone who succeeds in keeping the larvæ alive sufficiently long to undergo their transformation into beetles. Efforts in that direction have so far failed, but it is important that they should be continued.

But there may be another solution to the problem. The female glowworm and the females of certain other beetles have a form very like that of their larvæ, and never develop wings or elytra; they can, however, be distinguished from their larvæ by the structure of their antennæ and legs, with their greater number of joints, and by the possession of compound instead of simple eyes. There is, however, one group of beetles, the Phengodini, in which the female continues always to have the external form and

structure of the larva, with the same kind of eyes, antennæ and legs; whereas the adult male is an elegant beetle with fully developed wings, large compound eyes, and often provided with beautiful fan-like or feathered antennæ.

It is possible and, I think, even highly probable that some of our "trilobite" larvæ, the females, remain always in the form of larvæ, and that the male larvæ ultimately become transformed into beetles. Whether this be so or not might be decided in either of two ways. If it were found by the dissection of a sufficiently large number of specimens that some of them contained eggs or ripened ovaries, it would be clear that the specimens containing them were adult females.

Again, if some of the larger individuals, such as might reasonably be supposed to be females, were kept alive, under observation, in a position in which the winged males could reach them, the advent of the males and their mating with the females might be seen. The advantage of any observation of this kind that may be made is that the male might be captured, and the identity of the species made possible. It is possible, of course, that the male also may retain always the form of the larva, but no case of the kind is yet known among the beetles, and I think it is very unlikely to occur.

There are two special reasons which make me think it highly probable that the females retain the larval form. In the first place, when examining a larva of this type from Ceylon, I found it to be full of eggs, and the specimen was therefore presumably an adult female. But there was a slight element of uncertainty in this case. The eggs might have been deposited there by some parasitic insect, though I consider this extremely unlikely owing to the size and the large number of the eggs.

In the second place, I have found that all the specimens of the genus *Lyropæus*, Waterh., in the British Museum Collection, though certainly not numerous, are all males; so that the females, unless exceptionally rare as compared with the males, must be of an entirely different form. I know of but one species (as yet undescribed) of this genus from Borneo, and of that species I have seen only one specimen. But the range of distribution of the genus corresponds pretty closely with that of the larvæ whose identity it is so desirable to know.

In one point of structure these larvæ differ from all other known beetle larvæ. They have a pair of very distinct

spiracles on the metasternum—one on each side of it near where it joins the mesosternum—spiracles as large as any of the others which are present. Some Lycid and Lampyrid larvæ have spiracles in a similar position, but very much reduced in size compared with the others, and probably altogether functionless in character.

Why the metathoracic spiracles should be so well developed in these "trilobite" larvæ is not quite clear. Their absence, or rudimentary condition, in other beetle larvæ is sometimes explained as being due to the need of room for the development of the wing muscles, and, if that be so, their presence would suggest that the larvæ possessing them never develop into winged insects. But, so far as I know, they are present in all of these peculiar larvæ. Are these larvæ, then, all of one sex, or is it possible that the larvæ of the males may be quite unlike those of the females?

Thus it will be seen that there are several questions of interest waiting to be settled by anyone who may succeed in tracing out the full life-history of those still problematic larvæ.

For the convenience of those readers of this Journal who may take a lively interest in the subject, I append a short list of books and papers in which reference is made to it:—

1. Perty, 'Observationes Nonnullæ in Coleoptera Indiæ Orientalis,' 1831, p. 33, pl. i. figs. 8 and 9.
2. Westwood, 'Introduction to the Modern Classification of Insects,' 1839, vol. i. pp. 254, 255, fig. 27, 1, and fig. 28, 1.
3. Erichson, in Wiegman's 'Archiv fur Naturgeschichte,' 1841, i. p. 91.
4. Candèze, 'Histoire des Métamorphoses de quelques Coléoptères Exotiques,' 1861, pp. 29–34, pl. iii. fig. 1.
5. Kolbe, 'Entomologische Nachrichten,' vol. xiii. 1887, p. 37.
6. Gahan, 'Natural Science,' vol. xii., 1898, p. 43, fig. 2.
7. Sharp, 'Cambridge Natural History,' Insects, part ii. 1899, p. 251.
8. Bourgeois, 'Bull. Soc. Entom. de France,' 1899, pp. 58–63, figs. 1 and 2.
9. Gahan, 'Proc. Ent. Soc. London,' 1908, p. xlviii.